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ART UNIT	PAPER NUMBER
2825	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/902,672	FUNABASHI, MICHIMASA	
	Examiner	Art Unit	
	Lex Malsawma	2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 May 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *17-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *17-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. *09/392,568* .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 17-21, 23-26, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi et al. (5,990,060, hereinafter, "Ohmi") in view of Wang (6,087,243) and Okutani (5,135,608).

Regarding Claims 17-20, 23, and 25:

Ohmi discloses the following:

a processing solution containing hydrogen peroxide, hydracid fluoride salt (e.g., tetraalkyl ammonium fluoride), and water (note TABLE 1, in col. 9);

the processing solution includes HF and HF_2^- as etching seeds of silicon oxide (note col. 2, lines 32-34);

the processing solution can be utilized with ultrasonic vibration during the cleaning of a silicon wafer (note col. 3, line 67 to col. 4, line 44);

the processing solution can be utilized for cleaning the silicon wafer at a temperature as low as 40 °C (note col. 5, lines 7-16);

the processing solution is used to remove foreign materials deposited on a substrate after photoresist for ion injection or reactive ion etching is removed (note col. 2, lines 7-13), wherein a manufacturing process, including a cleaning process which utilizes the processing solution, is

preferably performed with an apparatus comprising a plasma processing device (for photoresist removal) directly connected (or provided adjacent) to an ion injection device (or a reactive ion etching device), while a cleaning device is directly (or provided adjacent) to the plasma processing device (note col. 5, lines 41-62); and

a method of utilizing the processing solution comprising:

(a) providing a silicon wafer 3 covered with an insulating film 3 whose main surface is mainly formed of silicon oxide 4 (note Figs. 3), wherein the surface contains foreign material 6 from a previous step of removing a photoresist (note Fig. 5); and

(b) cleaning the surface of said silicon wafer with said processing solution such that the foreign material 6 is removed from the mainly silicon oxide surface (Fig. 6).

Ohmi **lacks** the following:

(1) specifying a sheet-by-sheet cleaning process;

(2) the device manufacturing process step (c) of removing the insulating film after the step (b) of cleaning to expose the surface to the silicon wafer; and

(3) the device manufacturing process step (d) of subjecting the silicon wafer to a heat-treatment after step (c) thereby to form a gate oxide film over the silicon wafer.

In regards to lacked-limitation (1), it is noted Ohmi discloses it is preferable to utilize a multi-module apparatus when implementing the cleaning process (note col. 5, lines 51-62). Okutani **teaches** a multi-module apparatus would have been available, wherein the multi-module apparatus has the ideal features necessary for implementing Ohmi's cleaning process into a semiconductor device manufacturing method. Okutani discloses (note abstract and Fig. 1) the apparatus allows dry processing and wet processing to be continuously effected without exposing

the wafer to air (i.e., a contaminating atmosphere outside of the apparatus) wherein a substrate can be processed in a sheet-by-sheet manner. Therefore, lacked-limitation (1) is not considered to have patentable weight because an apparatus for sheet-by-sheet processing would have been commercially available at the time the current invention was made.

In regards to lacked-limitations (2) and (3), it important to note that Ohmi does not disclose, or is not specifically concerned with disclosing, process steps for forming any particular device, but rather, Ohmi discloses only process steps (or conditions) necessary to clean a substrate utilizing the processing solution. In other words, Ohmi discloses a most important aspect of the current invention, i.e., a processing solution which contains hydrogen peroxide, hydracid fluoride salt, and water; and Ohmi discloses only pertinent steps for utilizing the processing solution in a cleaning process, wherein the cleaning process would be just one process out of a plurality of processes that would be required during a semiconductor device fabrication, for example, other processes such as an ion-implantation process, a metallization process, a via forming process, etc. would also be necessary in a semiconductor device fabrication. Wang is cited to show processes that would typically be included in a semiconductor device fabrication. Wang **teaches** (in col. 2, lines 12-41) a pad oxide layer (i.e., a sacrificial oxide layer) is first formed on a surface of a substrate; various process steps are then performed, including an ion implantation step to form a retrograde well (note col. 2, lines 30-31); then remaining portions of the pad/sacrificial oxide layer is then removed (col. 2, lines 36-37); and after removal of said remaining portions, a gate oxide film is grown over the silicon wafer, wherein the gate oxide would most probably be thermally grown (note col. 2, lines 38-40) as is common in the art. The following important note is necessary at this point:

In regards to Wang's disclosure of performing an ion implantation step (to form a retrograde well) prior to removing the remaining pad/sacrificial oxide, one of ordinary skill in the art would have realized that the ion implantation step would be performed by utilizing a resist pattern which is later removed, even though Wang does not specifically disclose the steps for the ion-implantation process. For example, note Ohmi's disclosure in col. 5 (lines 41-50), "[r]esist is always required from the photolithographic process to the next ion implantation process...". One of ordinary skill in the art would realize that numerous resist patterning and removal steps are generally required during device fabrication, wherein according to Ohmi's disclosure, the cleaning solution (and process of cleaning) would be utilized at least after one resist-pattern-removal step, more specifically, Ohmi would be applied after removing a resist pattern which had been formed on top of a silicon oxide layer (note again, Ohmi's Figs. 3-6).

Returning to Wang, in Figs. 1A-1D and col. 6 (line 19) to col. 7 (line 25), a specific device manufacturing process is disclosed, and initially, it is noted that this process is very similar to the process disclosed in the current specification (see Figs. 3-8, 10, and 11 of Applicants' drawings). The point being made is that both Wang and Applicants are utilizing the common practice of:

(i) forming a pad/sacrificial oxide on a silicon wafer;

(ii) performing various processing steps including an ion implantation step "utilizing a resist mask" to form a well, wherein the resist mask is formed directly on the pad/sacrificial oxide layer;

(ii) removing the resist mask which was formed on the pad/sacrificial oxide;

(iii) removing portions of the pad/sacrificial oxide layer; and

(iv) growing a gate oxide film over the silicon wafer.

In regards to the instant claims, the issue of patentability rests on whether or not it would have obvious to one of ordinary skill in the art to utilize Ohmi's processing solution (and cleaning process) to clean the silicon wafer after step (ii) but before step (iii) of said common practice. Ohmi teaches the processing solution (and cleaning process) was invented for the very purpose of removing foreign material remaining on the surface of a silicon oxide layer (i.e., a pad/sacrificial oxide surface), wherein the foreign material is a direct result of removing a resist mask which had been formed on the silicon oxide surface. Ohmi discloses in "Background Technology", cols. 1-2) prior art problems associated with foreign materials remaining after resist removal; and in col. 2 (lines 8-20), col. 3 (lines 42-47), and col. 11 (lines 29-36), Ohmi discloses the advantages of cleaning a wafer surface utilizing the processing solution. Therefore, ***it would have been obvious*** to one of ordinary skill in the art to implement Ohmi into a typical semiconductor manufacturing process (similar to that shown by Wang), wherein Ohmi's processing solution (and cleaning process) is utilized after a step of removing a resist mask which had been formed on a pad/sacrificial oxide layer ***because*** problems caused by foreign materials (from the resist mask) remaining on the pad/sacrificial oxide surface can be avoided, since Ohmi's processing solution and cleaning process will remove the foreign materials with an additional advantage of being able to perform the cleaning process at a low temperature (note Ohmi, col. 1, lines 51-65, and col. 5, lines 7-10). Lastly, utilizing an apparatus as shown by Okutani would allow Ohmi's processing solution and cleaning process to be utilized directly after any resist removal step and before any subsequent film forming steps, wherein the apparatus will allow Ohmi to be implemented between various processing stages without

exposing the substrate/wafer to a contaminating atmosphere, since the "wet process" of Ohmi can be continuously performed with various "dry processes" by using such an apparatus.

Regarding Claim 21:

Ohmi specifies the density of ammonium fluoride (i.e., hydracid fluoride salt) is in a range of 0.05 to 49 weight % (note the sentence bridging cols. 2-3), and if tetra-methyl ammonium fluoride is used for the hydracid fluoride salt, then the density is in the range of 0.05 to 60 weight %. In other words, if ammonium fluoride (NH_4F, formula weight = 37grams, i.e., 1mol of NH_4F weighs 37 grams) is used as the hydracid fluoride salt, and if the density specified by Ohmi is interpreted in grams/liter (g/L), then Ohmi could be interpreted as specifying a range 0.05 to 49 grams per liter (i.e., a range of 0.05g/L to 49g/L of NH_4F), which would convert to a range in molarity of about 0.0013 *M* to 1.324 *M* (i.e., an range of 0.0013 mol/L to 1.324 mol/L of NH_4F). It is noted that no specific hydracid fluoride salt is specified in Claim 17, therefore, the claimed range in molarity (i.e., 0.1 to 3 mol/L) is held obvious over the cited references because Ohmi could be interpreted as disclosing a molarity within the claimed range. In any case, Ohmi (in view of Wang and Okutani) discloses the general conditions of the instant claim, and it would have been obvious to one of ordinary skill in the art to specify a concentration of 0.1 to 3 mol/L for the hydracid fluoride salt, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding Claims 24, 29, 30:

The apparatus disclosed by Okutani allows for transporting the silicon wafer from one processing chamber (wet or dry processing) to another processing chamber without exposing the

silicon wafer to (a contaminating) atmosphere. Furthermore, the apparatus includes means for completely drying the wafer after a wet process (note Okutani, col. 4, lines 29-38) and means to immediately transfer the wafer to another processing chamber after drying the wafer. Therefore, the instant claims are held obvious over the cited references.

Regarding Claim 26:

Ohmi (in view of Wang and Okutani) discloses the general conditions of the instant claim, however, Ohmi does not specify any particular range for pH. It would have been obvious to one of ordinary skill in the art to specify a pH in a range of 6 to 11 for the processing solution, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges (i.e., range in pH) involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

3. Claim 22 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi (in view of Wang and Okutani) as applied to Claims 17 and 26 above, and further in view of Ohmi et al. (5,277,835, hereinafter, " '835 Patent").

Regarding Claims 22 and 27:

Ohmi (in view of Wang and Okutani) **lacks** a surfactant being included in the processing solution. The '835 Patent **teaches** it was well known in the art to include a surfactant into a processing solution wherein the wettability of the processing solution can be improved such that smoothness of a surface being treated can be achieved during a cleaning step (note col. 1, line 62 to col. 2, line 52). It would have been obvious to one of ordinary skill in the art to modify Ohmi

(in view of Wang and Okutani) by including a surfactant because such a modification could ensure smoothness of a surface being cleaned by the processing solution.

4. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi (in view of Wang and Okutani) as applied to Claim 17 above, and further in view of Wolf ("Silicon Processing for the VLSI Era: Volume I", 1986).

Regarding Claim 28:

Ohmi (in view of Wang and Okutani) disclose the general conditions of the instant claim except for specifying parameters for growing the gate oxide film. Wolf is cited only to show that it was very well known in the art that thermal oxide can be grown by a heat treatment preformed in a mixed atmosphere of water and oxygen at a temperature in a range of 800° to 900 °C (see underlined text in pages 198 and 201). The instant claim is held obvious over the cited references primarily because the claimed parameters are typically utilized when forming a thermal oxide layer.

Remarks

5. Applicant's remarks have been carefully review and fully considered, however, they are moot in view of the new grounds of rejections. In general, all pending claims are held obvious over the cited references primarily because Ohmi (5,990,060) discloses a most important aspect of the current invention, i.e., Ohmi discloses a processing solution as currently claimed, and one of ordinary skill in the art would have found it obvious to utilize Ohmi's processing solution as currently claimed (in Claim 17), since Applicant specifies that the cleaning step is performed

after removing a photoresist mask which was formed on a silicon oxide layer, wherein the photoresist mask was utilized during ion implantation/injection (note photoresist "9" and silicon oxide "5" in Figs. 7-10 of Applicant's drawings). The point, during the manufacturing process, at which Applicant specifically cleans the substrate (with the processing solution) would be the ideal time to utilize Ohmi's processing solution (and cleaning process) because Ohmi specifies the processing solution was invented for the purpose of removing residual material remaining after photoresist is removed, wherein the photoresist was utilized for a processes including ion implantation, reactive ion etching, and/or plasma processing.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hong (5,525,535), Sung (5,550,078), and Saga et al. (5,679,171) are cited to show typical process steps comprising pad/sacrificial oxide formation and removal prior to gate oxide formation, wafer cleaning using similar processing solution, etc.

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 703-306-5986.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 703-308-1323. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Lex Malsawma

July 13, 2002

MATTHEW SMITH
SUPERVISORY PATENT EXAMINER
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